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LONG-TERM GOALS

In an inter-disciplinary context:

- *(a)* improve understanding, through in situ and remote sensing, of the circulation and dynamics of upwelling regimes on the sub-tropical eastern boundary and elsewhere with emphasis on the role of shelf-ocean exchanges in biogeochemical cycles.
- *(b)* investigate the importance of oceanic island-induced perturbations of the wind and current fields in vertical and horizontal exchanges and their importance to larval retention.

OBJECTIVES

Specifically, to advance the production of a paper on the extent and continuity of the Panama-Colombia countercurrent and undercurrent through the southern Caribbean including the Guajira upwelling system, to discuss mutual interests for research in the Indian Ocean Arabia Sea upwelling, and to compare notes on island effects.

APPROACH

By combining a visit to the Miami Rosenstiel School of Atmospheric and Ocean Sciences (Mooers, Cowen and Smith) with attendance at the joint The Oceanography Society and Oceanology International exhibition (Brink and others), I was able to meet a wide range of colleagues, present a poster paper and have discussions on current research in which I am involved. Possibilities for future collaboration were explored and new contacts made.

TRAVEL COMPLETED

Table 1. Summary of visits conducted under this VSP.

Person Visited	**Position**	**Institution / Conference**	**Location**	**Scientific / Technical Purpose**	**Dates (mm/dd/yy)**
Dr Ken Brink and others	N/A	WHOI/TOS Conference	Miami Beach Conference Center	Indian Ocean Upwelling Experiments	04/02/01-04/05/01
Prof Sharon Smith	Professor	RSMAS	Miami	Indian Ocean Upwelling Experiments	04/13/01
Prof Bob Cowen	Dean	RSMAS	Miami	Oceanic island repercussions on larval distributions	04/11/01 and 04/12/01
Prof Chris Mooers	Director, Ocean Pred Exptl Lab (OPEL), Div of Applied Mar Physics	RSMAS	Miami	Caribbean Circulation project	04/09/01-04/13/01

RESULTS

Apart from the pre-arranged work and planned discussions, attendance at the TOS/OI meeting allowed me to renew or establish contact with various colleagues working in areas related to mine and to attend the general sessions, as well as two workshops of particular interest on HF Radar and IOCaribe. On Day 2 of the meeting I presented my poster 'Physical controls of plankton distribution around Gran Canaria', which generated a good response although there were generally fewer people attending the poster sessions than I expected. All miniature copies of the poster were taken rapidly.

Unscheduled meetings of interest included one with Pierre Flament (University of Hawaii and IFREMER, France), which allowed us to carry out a 'post mortem' on a recent unsuccessful joint bid for EU funding. We discussed possible future proposals, with the conclusion that we should collaborate on the inclusion of an HF radar component in another bid to the EU on circulation on the Galician shelf and slope due for submission late this fall. A detailed outline for progressing this submission was agreed at a subsequent meeting. We also discussed exciting results arising from work on scatterometer winds carried out by a Master's student we

recently supervised jointly, in collaboration between University of Wales, Bangor and IFREMER. Surprisingly strong wind perturbation signals found behind many mountainous islands indicate an unsuspected persistence and widespread importance of the effect. A paper is planned shortly.

A short meeting with Jeff Paduan (NPS, Monterey) brought me up to date on some aspects of his recent work with HF radar on the west coast. The present lack of a commercial competitor for Codar given the apparent lack of development of OSCR and uncertain timetable for the MCR has arguably slowed progress. Prices have remained high and considerable user expertise is still required with the effect that applications outside the US, particularly in Europe, have been relatively few. Dr Paduan kindly offered to demonstrate the NPS set up and arrange a tour of the installations should I visit Monterey.

The HF radar workshop on 4 and 5 April covered the history of development, through basic principles, practical set up, and frequency allocation problems to examples of on going work. One of the clearest lessons learned was the importance of antenna location site properties, especially the presence of metal structures, in distorting the theoretical response pattern so that a transponder survey must be made to determine the actual response. Further, the general improvement of comparisons with in situ data when spatial smoothing is included suggests the presence of important small scale variability at sub-cell scales. The difficulty of extending Lagrangian comparisons beyond a day supports this idea. Several talks showed the difficulty of comparing HF radar and other current results; often mean differences in excess of 10 cm/s were found with no obvious explanation. However, others showed dramatic improvement in comparisons when careful response surveys were made or antenna configuration was examined. The depth at which comparison currents are measured (usually by ADCP) was shown to be critical because it does not necessarily coincide with the effective depth of measurement of the HF radar, which varies with wind/wave conditions, tidal current and vertical shear, and the presence of buoyant plumes in ways not yet fully understood. Examples of successful continuous monitoring programs were provided by Monterey Bay and Southern California Bight presentations. These highlighted applications to biological problems of larval distributions and settlement patterns and indicated problems and methodologies for data interpretation and assimilation into models. Other interesting presentations included the use of bistatic (separated receive and transmit) systems and long range coverage (cf. www.marine.rutgers.edu/cool , www.thecoolroom.org), rapid response set ups for oil spill scenarios, Search and Rescue requirements for HF radar monitoring, ionospheric effects, and the increasing need for coordinated user response and technical solutions to the problem of bandwidth requirement and frequency allocation by national and international authorities. This was a most useful workshop particularly from the techniques and practical applications viewpoint; presumably more emphasis on scientific results would be found at the Timberline meeting the week after TOS/OI.

The IOCaribe meeting was varied in topics and presentations, possibly reflecting the political and geographical fragmentation of the area. Talks ranged from climate change issues and monitoring plans on the regional scale to particularities of engineering solutions in coastal defence. Poorly managed artesanal fisheries and foreign fish fleets operate largely independently of any oceanographic information or advice. Little local scientific infrastructure is available to address recognized problems such as planktonic dispersal or retention, dispersion of pathogens and contaminants, and the effect of primary production on the distribution and migration of adult pelagic fishes. The lack of any strong scientific support from the ex-colonial powers in the Caribbean is perhaps surprising. Possibly because I missed many of the presentations attending the parallel HF radar workshop, I did not come away from the end of the meeting with any clear impression of the way forward.

Discussions with Ken Brink (WHOI) covered the UK NERC funded project I am coordinating in the Arabian Sea and possible work that he and others propose in the same region. Although the NERC project was predicated and funded on the availability of Discovery, difficulties within the UK ship time programme result in the smaller Charles Darwin being allocated to the project. Consequent reductions in the operational window for weather and the number of scientific berths threaten the viability of the project. Various scenarios were explored but the only feasible response seems to be to accept the logistical limitations and attempt to tailor the field programme to the reduced facilities. Prof Brink's expectation was that his proposed Indian Ocean work will take place in 2003, one year after ours, so direct collaboration is not possible. However we agreed to maintain close contact over developments. I was introduced to and spoke briefly about our project with John Kindle (NRLSSC) who, because of his strong interest in the Arabian Sea, offered to provide wind data and other information useful to our operations.

I had an unscheduled meeting with Dr Igor Belkin (University of Rhode Island) for whom I have agreed to contribute a book chapter related to oceanic fronts in upwelling systems. We discussed his work on frontal persistence in SST imagery and I was able to direct him and Dr Suhung Shen (DAAC), also involved in the conversation, to the recent algorithm development for automated detection and tracking of ocean temperature and colour fronts done by Peter Miller at the Plymouth Marine Laboratory, UK.

I spent Friday, after the meeting, putting finishing touches to a talk I had prepared for RSMAS at Dr Sharon Smith's invitation. Monday I was installed in Chris Mooers' office, attended some of his SCOR Coastal Seas modeling workshop and started work on the Caribbean manuscript. Unfortunately, Dr Carlos Andrade the principal author was unable to travel from Colombia to coincide with my visit so progress on the paper was not great as expected. However during the course of the week Chris Mooers and I, with the help of some phone calls to Carlos in Cartagena, made extensive revision to the manuscript and suggested further analysis and changes to be executed by the first author. By the end of the week, a detailed list of amendments and actions were e-mailed to Carlos for action as soon as possible so that journal submission will happen shortly.

During the week, I attempted to see Sharon Smith but she had been delayed in Colorado by snow storms and could not get back until the Friday. Because of an already crowded seminar schedule and Sharon's absence I did not give the seminar (however have since presented it elsewhere). When I finally did meet with her, our discussions covered mainly the same ground as with Ken Brink. Sharon was strongly persuasive that we should carry on with our experiment even if reduced in objectives and scope.

Finally, I had detailed talks with Robert Cowen and his research assistant Claire Paris about our work on ocean islands. I was impressed by their work on three-dimensional circulation during detailed studies of Barbados and believe that similar approach would be very useful in our work around the Canary Islands. The nature of the variability in the two areas is quite different, but the same techniques are applicable. I am considering a proposal with biological colleagues to examine the relation between physical conditions and fish egg and larvae distributions around Gran Canaria and would certainly include this approach

IMPACT/APPLICATIONS

The visit has provided me with a knowledge of the state of the art in HF radar estimation of near-surface currents and an improved understanding of the politics of science in the Caribbean. The former will be of considerable direct use in my future planned observational work, while the latter will colour my considerations of possible projects. Although direct collaboration in our Indian Ocean projects has not proven possible because of ship time and project funding schedules, we have reinforced our contacts and will maintain our scientific links as a result of our meetings. Agreement with Prof Flament on joint participation in an EU proposal arose directly from our meeting in Miami.

RELATED PROJECTS

I participated in the recent EU funded Canigo project in relation to shelf-ocean exchanges in a persistent upwelling filament off NW Africa (www.marine.ie/datacentre/projects/canigo/ and www.sos.bangor.ac.uk/~oss041/fax99/Templates/welcome.htm) and in the OMEX II project off northern Iberia (www.bodc.ac.uk/projects/omexii-ii.html).

PUBLICATIONS

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